



George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

QS-R-002
REVISION D

EFFECTIVE DATE: October 1, 2004

ORGANIZATIONAL INSTRUCTION

RELIABILITY BLOCK DIAGRAMS

OPR(s)

**QD10, QD20, QD30,
QD40**

OPR DESIGNEE

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DOCUMENT HISTORY LOG

Status (Baseline/ Revision/ Canceled)	Document Revision	Effective Date	Description
Baseline		11/20/97	
Revision	A	7/1/99	Changes made to reflect new organization code changes and/or Changes made to reflect new directives renumbering scheme and to incorporate the corrective action for closure of NCR 266
Revision	B	9/09/02	Format and numbering change to implement requirements of QS-A-001 rev F.
Revision	C	10/20/03	Added applicable and reference documents, revised Instructions
Revision	D	10/1/04	Updated OI to implement HQ Rules Review in accordance with CAITS Action # 04-DA-01-0387) (Utilizing the word "Shall" for all requirements, removing ambiguity, removing non-requirements, etc.)

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Reliability Block Diagrams

1. PURPOSE, SCOPE, APPLICABILITY

1.1 Purpose

The purpose of this Organizational Instruction (OI) is to provide a procedure that shall be used for development of Reliability Block Diagrams (RBDs). RBDs are used when analyzing the reliability of all flight hardware and flight support equipment during the design, development, and operation phases.

1.2 Scope

Reliability block diagrams shall be used to model the various series-parallel and complex block combinations (paths) that result in item/system success.

1.3 Applicability.

This OI shall be applicable to all S&MA personnel supporting MSFC programs and projects that require or specify reliability requirements. It may be used as a quantitative tool for mathematical process logic.

2. DOCUMENTS (Applicable and/or Reference)

2.1 Applicable Documents

NPD 8720.1 NASA Reliability and Maintainability (R&M) Program Policy

NASA-STD-8729.1 Planning, Developing and Managing an Effective Reliability and Maintainability (R&M) Program

2.2 Reference Documents

Reliability in Engineering Design, K.C. Kapur and L.R. Lamberson, 1977.

Reliability Toolkit: A Practical Guide for Commercial Products and Military Systems Under Acquisition Reform, Reliability Analysis Center

MIL-STD-756B, *Reliability Modeling and Prediction*

3. DEFINITIONS

All definitions applicable to this OI are addressed in NASA-STD-8729.1

4. INSTRUCTIONS

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A Reliability Block Diagram is a form of reliability analysis using a functional diagram to portray and analyze the reliability relationship of components in a system. Each element of a system shall be represented by a block that is in some way interconnected with or through the other blocks of the system at a desired level of assembly. The basic relationship between components are depicted as lines that may be:

- parallel, if no redundant unit failure causes system failure
- series, if single failure results in entire assembly or system failure
- or a combination of these two lines

The reliability block diagram does not follow a schematic flow pattern but instead follows the probabilistic success path relationships between components.

In developing the reliability block diagram, a complete understanding of an item's mission definition and service use profile is required. In addition, the system shall be broken down into subsystems/functions that are necessary for mission success. Each essential function shall be represented as a separate block in the diagram, and blocks shall be grouped according to series-parallel combinations. Lines shall be drawn connecting the blocks in a logical order for mission success. A flow diagram of the described reliability block diagram instruction steps are illustrated in Section 11. Some common reliability block diagram configurations are depicted in Attachment 1.

The reliability block diagram shall be updated as appropriate (i.e., with design changes or design evolution).

<u>Steps</u>	<u>Action</u>
4.1	Define system for analysis.
4.2	Break system into elements.
4.3	Determine series-parallel combinations. (See attachment 1).
4.4	Represent each element as a separate block in the diagram.
4.5	Draw lines connecting the blocks in a logical order for mission success.

5. NOTES

5.1 Directive Replacement. This Directive replaces S&MA-CR10-R-Y-002, Reliability Block Diagrams.

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5.2 Records:

Included in other reliability/maintainability analysis task documents.

6. SAFETY PRECAUTIONS AND WARNING NOTES

None.

7. APPENDICES, DATA, REPORTS, AND FORMS

None.

8. QUALITY RECORDS

None

9. TOOLS, EQUIPMENT, AND MATERIALS

The user shall define any tools, special equipment, or materials used during the reliability block diagram process.

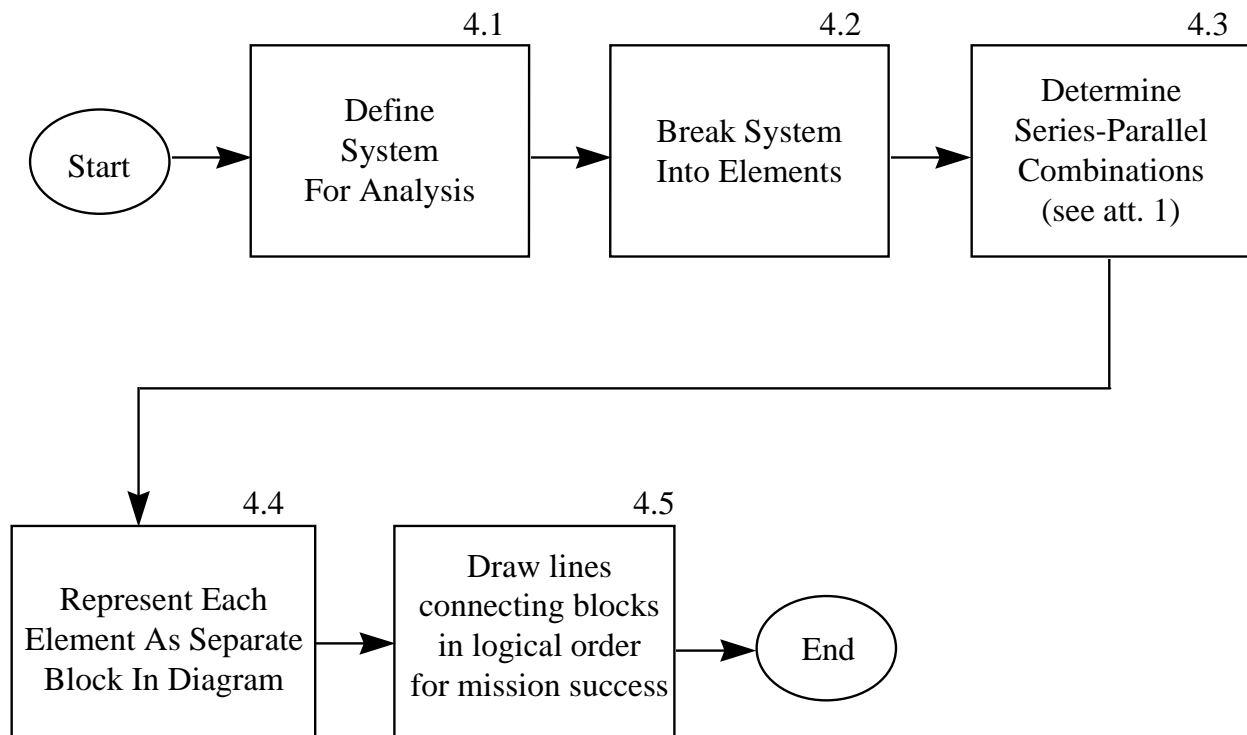
10. PERSONNEL TRAINING AND CERTIFICATION

Reliability training shall include reliability block diagram development.

11. FLOW DIAGRAM

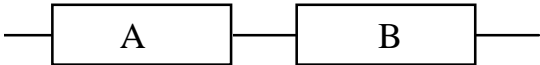
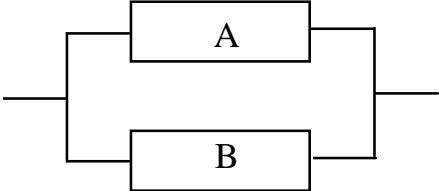
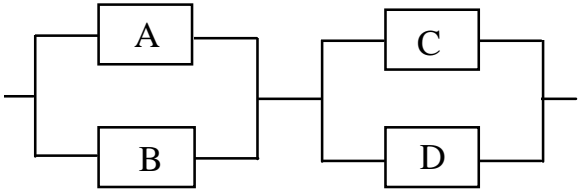
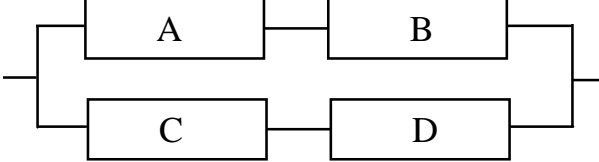
The following flow diagram represents the Reliability Block Diagram instructions outlined in Section 4.

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Attachment 1
Series-Parallel Combinations

Type Branch	Block Diagram Representation	System Reliability #
Series		$R_S = R_A * R_B$
Parallel		$R_S = 1 - (1 - R_A)(1 - R_B)$
Series-parallel		$R_S = 1 - (1 - R_A)(1 - R_B) * (1 - (1 - R_C)(1 - R_D))$
Parallel-series		$R_S = 1 - (1 - (R_A * R_B)) * (1 - (R_C * R_D))$
Complex	